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Evaluation of the regional climate model RegCM4.7 over the Carpathian region for very wet and average years

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Precipitation is one of the most important climate variables in many aspects due to its key impact on agriculture, water management, etc. However, it remains a challenge for climate models to realistically simulate the regional patterns, temporal variations, and intensity of precipitation. The difficulty arises from the complexity of precipitation processes within the atmosphere stemming from cloud microphysics, cumulus convection, large-scale circulations, planetary boundary layer (PBL) processes, and many others. This is especially true for heterogeneous surfaces with complex orography such as the Carpathian region. Thus, the Carpathian Basin, with its surrounding mountains, requires higher model resolution, along with different parameterizations, compared to more homogenous regions. The aim of the study is to reproduce the historical precipitation pattern through testing the parameterization of surface processes. The appropriate representations of land surface component in climate models are essential for the simulation of surface and subsurface runoff, soil moisture, and evapotranspiration. Furthermore, PBL strongly influences temperature, moisture, and wind through the turbulent transfer of air mass. The current study focuses on the newest model version of RegCM (RegCM4.7), with which we carry out simulations using different parameterization schemes over the Carpathian region. We investigate the effects of land-surface schemes (i.e. BATS - Biosphere-Atmosphere Transfer Scheme and CLM4.5 - Community Land Model version 4.5) in the regional climate model. Studies over different regions have shown that CLM offers improvements in terms of land–atmosphere exchanges of moisture and energy and associated surface climate feedbacks compared with BATS. Our aim includes evaluating whether this is the case for the Carpathian region.

Four 1-year-long experiments both for 1981 and 2010 (excluding the spin-up time) are completed using the same domain, initial and lateral atmospheric boundary data conditions (i.e. ERA-Interim), with a 10 km spatial resolution. These years were chosen because 1981 was a normal year in terms of precipitation, while 2010 was the wettest year in Hungary from the beginning of the 20th century. We carry out a detailed analysis of RegCM outputs focusing not only on standard climatological variables (precipitation and temperature), but also on additional meteorological variables, which have important roles in the water cycle (e.g. soil moisture, evapotranspiration). The simulations are compared with the CARPATCLIM observed, homogenised, gridded dataset and other databases (ESA CCI Soil Moisture Product New Version Release (v04.5) and Surface Solar Radiation Data Set - Heliosat (SARAH)). It is found that the simulated near-surface temperature and

precipitation are better represented in the CLM scheme than in the BATS when compared with observations, both over the lowland and mountainous area. The model simulations also show that the precipitation is overestimated more over mountainous area in 2010 than in 1981.